

What is claimed is:

1       1. A mount suitable for passive-active vibration isolation in  
2 association with variable loading, said mount comprising a first member  
3 for attaching to a first entity, a second member for attaching to a second  
4 entity, at least one streamlined resilient member, and at least one  
5 structurally-positionally and functionally-directionally collocational  
6 combination of a sensor and an actuator; each said streamlined resilient  
7 element at least substantially consisting of an elastomeric material and  
8 being interposed between said first member and said second member; each  
9 said streamlined resilient element being characterized by low dynamic  
10 load transmissibility of vibration in approximately the same frequency  
11 bandwidth over a broad loading range; said at least one streamlined  
12 resilient element thereby being capable of effectuating overall passive  
13 reduction of the transmission of vibration from said first member to said  
14 second member; said overall passive reduction being of vibration in  
15 approximately the same first frequency bandwidth over a broad loading  
16 range of said first entity; each said collocational combination having a  
17 corresponding region of said second member; each said collocational  
18 combination being capable of generating a sensor signal and an actuator  
19 vibratory force; said sensor signal being representative of the local

vibration in the corresponding region and being representable as a control signal; said vibratory force being representative of said control signal; each said collocational combination thereby being capable of effectuating, in the corresponding region, localized active reduction of the transmission of local vibration which has reached said second member subsequent to the effectuating of said overall passive reduction; said localized active reduction being of vibration in a non-first frequency bandwidth which differs from said first frequency bandwidth.

2. A mount as recited in claim 1, wherein at least one said streamlined resilient element includes at least one truncation surface, each said truncation surface adjoining one of said first member and said second member.

3. A mount as recited in claim 1, wherein each said streamlined resilient element at least substantially describes a shape which is selected from the group consisting of sphere, prolate spheroid, cylinder, torus and torus segment.

4. A mount as recited in claim 3, wherein at least one said streamlined resilient element includes at least one truncation surface,

3           each said truncation surface adjoining one of said first member and said  
4           second member.

1           5. A mount as recited in claim 4, wherein:  
2           said first member approximately describes a first plane;  
3           said second member approximately describes a second plane which  
4           is approximately parallel to said first plane;

5           5 if said streamlined resilient element at least substantially describes  
6           a cylinder shape, said streamlined resilient element approximately defines  
7           a longitudinal axis which is approximately parallel to said first plane and  
8           said second plane;

9           9 if said streamlined resilient element at least substantially describes  
10          a torus shape, said streamlined resilient element approximately defines a  
11          longitudinal axis which lies in a third plane which is approximately  
12          parallel to said first plane and said second plane; and

13          if said streamlined resilient element at least substantially describes  
14          a torus segment shape, said streamlined resilient element approximately  
15          defines a longitudinal axis which lies in a third plane which is  
16          approximately parallel to said first plane and said second plane.

1           6. A mount as recited in claim 3, wherein:

2                   said first member approximately describes a first plane;

3                   said second member approximately describes a second plane which

4                   is approximately parallel to said first plane;

5                   if said streamlined resilient element at least substantially describes

6                   a cylinder shape, said streamlined resilient element approximately defines

7                   a longitudinal axis which is approximately parallel to said first plane and

8                   said second plane;

9                   if said streamlined resilient element at least substantially describes

10                  a torus shape, said streamlined resilient element approximately defines a

11                  longitudinal axis which lies in a third plane which is approximately

12                  parallel to said first plane and said second plane; and

13                  if said streamlined resilient element at least substantially describes

14                  a torus segment shape, said streamlined resilient element approximately

15                  defines a longitudinal axis which lies in a third plane which is

16                  approximately parallel to said first plane and said second plane.

1                   7. A mount as recited in claim 1, wherein said broad loading range

2                   associated with said overall passive reduction is between a minimum load

3                   value and a multiple load value of the minimum load value, and wherein

4                   said multiple load value is between approximately ten times and

5                   approximately one hundred times said minimum load value.

1           8. A vibration isolator which is adapted for engagement with a  
2 processor/controller, said processor/controller being capable of generating a  
3 control signal, said vibration isolator comprising:

4           a spring assembly which includes a top member for securing said  
5 spring assembly with respect to an isolated entity, a bottom member for  
6 securing said spring assembly with respect to an isolatee entity, and at  
7 least one interposed streamlined resilient member, each said streamlined  
8 resilient member being at least substantially composed of an elastomeric  
9 material, each said streamlined resilient member having the property of  
10 passively reducing vibration within a special passive-reduction-related  
11 frequency bandwidth which is at least substantially constant when said  
12 streamlined resilient member is subjected to a wide range in terms of the  
13 degree of loading, said at least one streamlined resilient member thereby  
14 being capable in net effect of passively reducing vibration within a general  
15 passive-reduction-related frequency bandwidth which is at least  
16 substantially constant when said streamlined resilient member is  
17 subjected to a wide range in terms of the degree of loading which is  
18 associated with at least one of said isolated entity and said isolatee entity;

19           at least one sensor, each said sensor being coupled with said bottom  
20 member and being capable of generating a sensor signal which is in

21 accordance with the vibration in a local zone of interest in said bottom  
22 member; and

23 at least one actuator, each said actuator being coupled with said  
24 bottom member and being collocationally paired with one said sensor so as  
25 to share approximate coincidence with respect to both physical situation  
26 and operational direction, each said actuator being capable of generating,  
27 in said local zone of interest of said sensor with which said actuator is  
28 collocationally paired, a vibratory force which is in accordance with said  
29 control signal, wherein said control signal is in accordance with said sensor  
30 signal which is generated by said sensor with which said actuator is  
31 collocationally paired, wherein said vibratory force has the tendency of  
32 actively reducing vibration within an active-reduction-related frequency  
33 bandwidth which differs from said general passive-reduction-related  
34 bandwidth.

1 9. A vibration isolator as defined in claim 8, wherein said general  
2 passive-reduction-related bandwidth is approximately commensurate with  
3 said special passive-reduction-related bandwidth.

1 10. A vibration isolator as defined in claim 8, wherein at least one  
2 said streamlined resilient element includes at least one truncation surface,

3           each said truncation surface adjoining one of said top member and said  
4           bottom member.

1           11. A vibration isolator as defined in claim 8, wherein:

2           to at least a substantial degree, each said streamlined resilient  
3           element has a shape which is selected from the group consisting of  
4           spherical, prolate spheroidal, cylindrical, toroidal and segmentedly  
5           toroidal;

6           said top member has a top member bottom surface which  
7           approximately defines an upper plane;

8           said bottom member has a bottom member top surface which  
9           approximately defines a lower plane which is approximately parallel to  
10          said upper plane;

11          if said shape is cylindrical, said streamlined resilient element  
12          approximately defines an imaginary central axis which is approximately  
13          intermediate and approximately parallel to said upper plane and said  
14          lower plane;

15          if said shape is toroidal, said streamlined resilient element  
16          approximately defines an imaginary central axis which lies in a third  
17          plane which is approximately intermediate and approximately parallel to  
18          said first plane and said second plane; and

19           if said shape is segmentedly toroidal, said streamlined resilient  
20          element approximately defines an imaginary central axis which lies in a  
21          third plane which is approximately intermediate and approximately  
22          parallel to said first plane and said second plane.

1           12. A vibration isolator as defined in claim 11, wherein at least one  
2          said streamlined resilient element includes at least one truncation surface,  
3          each said truncation surface adjoining one of said top member and said  
4          bottom member.

5           13. A vibration isolator as defined in claim 8, wherein said wide  
6          range, in terms of the degree of loading which is associated with at least  
7          one of said isolated entity and said isolatee entity, is approximately a  
8          range which is between a minimum loading value and a maximum loading  
9          value, said maximum loading value being between ten times and one  
10         hundred times said minimum loading value.

11           14. A vibration isolation system; said vibration isolation system  
12          being for reducing the transmission of vibration of a first entity to a second  
13          entity; said vibration isolation system comprising a spring assembly and a  
14          feedback loop system; said spring assembly being for effectuating global

5 passive vibration control; said feedback loop system being for effectuating  
6 localized active vibration control subsequent to said effectuating of said  
7 global passive vibration control; said spring assembly including a first  
8 securement member, a second securement member and at least one  
9 interposed streamlined resilient element; said first securement member  
10 being for securing said spring assembly with respect to said first entity;  
11 said second securement member being for securing said spring assembly  
12 with respect to said second entity; said at least one streamlined resilient  
13 member being essentially elastomeric; said at least one streamlined  
14 resilient element passively reducing the transmission of vibration of said  
15 first entity to said second entity; said passively reduced vibration existing  
16 in at least a first frequency bandwidth; said first frequency bandwidth  
17 being generally constant within a broad scope of the amount of loading  
18 upon said at least one streamlined resilient element by at least one of said  
19 first entity and said second entity; said feedback loop system including at  
20 least one sensor, a PID-type controller and at least one actuator; said at  
21 least one sensor being coupled with said second securement member; each  
22 said sensor generating a sensor signal which is a function of the vibration  
23 in a localized control area of said second securement member; said PID-  
24 type controller generating at least one control signal which is a function of  
25 said at least one sensor signal; said at least one actuator being coupled

26       with said second securement member; each said actuator generating, in  
27       said localized control area, a vibratory force which is a function of a said  
28       control signal; said at least one actuator, by said generating, reducing the  
29       transmission of vibration of said first entity to said second entity; said  
30       vibration existing in at least a second frequency bandwidth; said at least a  
31       first frequency bandwidth and said at least a second frequency bandwidth  
32       being generally dissimilar; said at least one sensor and said at least one  
33       actuator being collocated whereby each said sensor and one said actuator  
34       are approximately coincident and whereby the sensing of each said sensor  
35       and the actuation of the corresponding said actuator are approximately in  
36       the same direction.

1               15. The vibration isolation system according to claim 14, wherein at  
2       least one said streamlined resilient element at least substantially defines a  
3       spherical shape.

1               16. The vibration isolation system according to claim 14, wherein at  
2       least one said streamlined resilient element at least substantially defines a  
3       prolate spheroidal shape.

1               17. The vibration isolation system according to claim 14, wherein at

2           least one said streamlined resilient element at least substantially defines a  
3           cylindrical shape.

1           18. The vibration isolation system according to claim 14, wherein at  
2           least one said streamlined resilient element at least substantially defines a  
3           torus shape.

1           19. The vibration isolation system according to claim 14, wherein at  
2           least one said streamlined resilient element at least substantially defines a  
3           segmented torus shape.

1           20. The vibration isolation system according to claim 14, wherein at  
2           least one said streamlined resilient element includes at least one  
3           truncation surface, each said truncation surface adjoining one of said first  
4           securement member and said second securement member.

1           21. The vibration isolation system according to claim 14, wherein  
2           said broad scope of the amount of loading approximately ranges between a  
3           minimum loading amount and a maximum loading amount, and wherein  
4           said maximum loading amount is approximately between ten times and  
5           one hundred times said minimum loading amount.

1           22. Apparatus for both passively and actively isolating the vibration  
2         of a structure situated over a foundation, said apparatus comprising:

3           a processor/controller;  
4           a spring device which passively reduces the transmission of said  
5         vibration from said structure to said foundation, said spring device  
6         including an upper member for fixing said spring device with respect to  
7         said structure, a lower member for fixing said spring device with respect to  
8         said foundation, and at least one streamlined resilient element, wherein:

9           each said streamlined resilient element is elastomeric and is  
10         so configured as to at least substantially exhibit the attribute of  
11         effecting passive reduction of the vibration existing at least nearly  
12         the identical frequency band over a significant range of the degree of  
13         loading imposed upon said streamlined resilient element;

14           said significant range is between a minimum degree of  
15         loading and a maximum degree of loading;

16           said maximum degree of loading is no less than about ten  
17         times said minimum degree of loading;

18           said maximum degree of loading is no more than about one  
19         hundred times said minimum degree of loading; and

20           said streamlined resilient element is so configured as to at  
21         least substantially describe one of a sphere, a prolate spheroid, a

22 cylinder, a torus and a torus segment; and  
23 at least one collocation of a sensor and an actuator wherein, for each  
24 said collocation:  
25                 said sensor and said actuator are each coupled with said  
26 lower member so as to be approximately identically located and  
27 approximately identically directed;  
28                 said sensor senses the local vibration in a portion of said  
29 lower member and produces an electrical sensor signal  
30 commensurate with said local vibration;  
31                 said processor/controller receives said electrical sensor signal  
32 from said sensor and produces an electrical control signal  
33 commensurate with said electrical sensor signal; and  
34                 said actuator receives said electrical control signal from said  
35 processor/controller and produces in said portion of said lower  
36 member a vibratory force commensurate with said electrical control  
37 signal, said vibratory force increasing the stability of said portion of  
38 said lower member, said actuator thereby effecting active reduction  
39 of the transmission of said vibration from said structure to said  
40 foundation whereby, in succession, said spring device passively  
41 reduces the transmission of said vibration and said actuator actively  
42 reduces the transmission of said vibration.

1           23. The apparatus according to claim 22, wherein at least one said  
2           streamlined resilient element is at least slightly truncated for facilitating  
3           connection to said upper member.

1           24. A method for reducing transmission of vibration of a first entity  
2           to a second entity, said method comprising:

3                 providing a spring assembly which includes at least one streamlined  
4                 resilient member, an upper securement member and a lower securement  
5                 member, said at least one streamlined resilient member being essentially  
6                 elastomeric and being for passively reducing the transmission of vibration  
7                 existing in at least a first plurality of frequencies, said first plurality of  
8                 frequencies falling within a generally constant bandwidth in relation to a  
9                 range of loading imposed upon said at least one streamlined resilient  
10                 element by at least one of said first entity and said second entity, said  
11                 range being between a minimum degree of loading and a maximum degree  
12                 of loading, said maximum degree of loading being no less than about ten  
13                 times said minimum degree of loading, said maximum degree of loading  
14                 being no more than about one hundred times said minimum degree of  
15                 loading, each said streamlined resilient element being shaped so as to at  
16                 least substantially describe one of a sphere, a prolate spheroid, a cylinder,

17           a torus and a torus segment; and

18                 engaging with said spring assembly a feedback loop system, said

19                 engaging including:

20                         establishing at least one collocation of a said sensor with a

21                         corresponding said vibratory actuator so that said sensor and said

22                         corresponding said vibratory actuator are each coupled with said

23                         lower securement member at approximately the same location, and

24                         so that said sensor senses and said corresponding said vibratory

25                         actuator actuates in approximately the same direction and in

26                         approximately the same locality of said lower securement member;

27                         connecting each said sensor and each said vibratory actuator

28                         with a processor/controller so that, for each said collocation, said

29                         sensor generates a sensor signal representative of the vibration of

30                         said locality, said processor-controller generates a control signal

31                         representative of said sensor signal, and said vibratory actuator

32                         generates a vibratory force representative of said control signal; and

33                         providing power for said feedback loop system; and

34                         mounting said first entity with respect to said second entity,

35                         said mounting including fastening said first entity with respect to

36                         said upper securement member and fastening said second entity

37                         with respect to said lower securement member;

38           wherein, in series, said spring assembly effects passive reduction of  
39           said vibration at said first plurality of frequencies, then said feedback loop  
40           system effects active reduction of said vibration at a second plurality of  
41           frequencies; and

42           wherein at least one frequency among said second plurality of  
43           frequencies is not among said first plurality of frequencies.

1           25. A method for reducing transmission of vibration as recited in  
2           claim 24, wherein said providing a spring assembly includes:

3           4           providing a streamlined resilient element which has a first  
5           truncation surface and a second truncation surface opposite said first  
6           truncation surface; and

7           8           joining said streamlined resilient element with each of said upper  
9           securement member and said lower securement member so that said first  
truncation surface abuts said upper securement member, and so that said  
second truncation surface abuts said lower securement member.

1           2           26. A method for reducing transmission of vibration as recited in  
3           claim 25, wherein said providing a streamlined resilient element includes  
4           effecting said first truncation surface and effecting said second truncation  
surface.